The Application and Research of RFID Technology in the Cigarette Storage System

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Abstract. This article introduces RFID (Radio Frequency Identification) technology into the cigarette storage system where the RFID tag plays a role as a covert cargo label which can be scanned on a cargo shelf. It has solved the difficulties including identifying the tag from the shelf's side, and swept the barriers such as environmental factors which have an impact on the ability of identifying the RFID tags. Based on the RFID tag, this paper has proposed a method of digitalizing the registration of cigarette tray storage which has different location levels and has resolved the issues of the original method that is complicated and confusing, slow and dislocated.

Introduction

In recent years, with the rapid development of information technology, the manufacturing mode and the manufacturing technology of modern manufacturing enterprises have undergone great changes. Industrialization and information technology have become interdependent and interacted. Modern manufacturing enterprises are digitalized networks connected by the Internet. Bar code technology, radio frequency identification technology and network technology are widely used in logistics management, which has greatly improved the level of intelligence and modernization in the logistics field, as well as operational efficiency, shortening operating time, reducing labor intensity.

Warehousing logistics is an important part of modern logistics, efficient and rational logistics can accelerate the speed of the flow of goods, significantly reduce logistics costs, guarantee smooth production. The wide utility of automated warehouse has brought great innovation to this field, but because of its shortcomings such as large investment, long construction period, high maintenance costs and lack of flexibility, the traditional multi-level shelves are irreplaceable and in large quantity. By applying the RFID, many of the traditional warehouses have been modernized, and a large number of logistics facilities and equipment related to the installation of RFID equipment have achieved digitalization.

Currently there are two main cigarette warehouse management systems: one is manual document management approach, which is time-consuming, inefficient, and it’s easy to make mistakes when filing the documents; the other is bar code management. Although it improves the efficiency, it has defects such as the bar code is easy to be worn out, polluted and it is not anti-humidity. omings, so that the storage mode there are some flaws. And the above two methods are only suitable for some small cigarette storage systems.

Every day the cigarette warehouse will have significant delivery, which is a major difference from other industries. Faced with such a high rate of delivery, the original storage mode
and delivery method cannot meet the real needs [1]. With the rapid development of information technology, RFID is widely applied, the technology can achieve real-time, accurate, high-speed acquisition and processing. Therefore, the cigarette tray storage system based on RFID has become the focus of the study storage system studies. It has the following features: improving the speed of storage and access, increasing productivity, reducing labor intensity; forming an advanced logistics system which improves the level of cigarette production management; improving space utilization and flexibility through wise methods; boasting an easy access to inventory information which could lead to timely and effective response to emergencies, providing the basis for cigarette production decisions; accelerating turnover of goods, making the connections between producing and selling smooth, reducing inventory backlog of funds and reduce costs.

This article introduce the RFID technology into the cigarette storage system. That is, using the RFID tag to put the goods in order through different levels. The new high efficient method has resolved the issues of the original method that is complicated and confusing, slow and dislocated.

**The status quo of RFID technology studies in logistics management**

Certain achievements have been made by scholars home and abroad in the application and research of RFID technology in logistics management. Such as logistics, the United States has more than 100 companies committed to supporting RFID applications, including: Wal-Mart, the manufacturer Gillette, Johnson & Johnson, Procter & Gamble, United Parcel Service Company in the logistics industry as well as Logistics Application in Department of Defense. European companies such as Philips and STMicroelectronics are actively developing inexpensive Checkpoint which can identify RFID; Nokia is developing an RF-based mobile phone shopping system; SAP is vigorously developing logistics management and application management software which support RFID[2]. In addition, RFID technology is applied to the logistics management system [4] which has multilevel functions including product recollection, examination, classification, integration, reprocessing, redistribution [3]. This method has become an important way to enhance the competitiveness and management efficiency of international enterprises.

At home, RFID technology started late, but since April 2004 Chinese enterprises and government departments have begun to focus on EPC and Internet of things [5], RFID technology has begun to be used in a small number of large enterprises in the country. In warehouse management, because of being influenced by Wal-Mart's RFID program, through the development of RFID technology, China's Haier Group have established two full-automated logistics center, and have set up their two own cargo management systems, improving warehouse management level, reducing the logistics operations cost, and lowering the rate of cargo’s information collection [6]. In Tianjin, the logistics are highly valued, which has been listed as one of the five pillars industries. When constructing the logistics application base, Tianjin Mobile Company puts a large number of mobile communication services and products’ application into the body of the logistics industry. Wireless POS and other products have realized into the deep combination in order processing, data transmission links warehouse management, inventory management, distribution scheduling, cargo tracking, transportation management, financial settlement and other subsystems so that we could expand the platform of logistics enterprises MIS, ERP, OA and other application systems and achieve mobility management. At present, Tianjin mobile logistics information has been deepened into major logistics enterprises, key projects such as Tianjin port logistics, GPS positioning ACE Group, Tianjin Customs SMS declaration, Tianjin tobacco distribution wireless POS applications, other Coca-Cola Company messages ERP and so on[7].
Cigarette storage systems architecture based on buried RFID cargo tag

Warehouse information management system is used by modern logistics enterprises for cargo management and business processing operating system, and it is also a software implementation tool which is used to manage the internal warehouse employees, inventory, business processes, orders and equipments. With warehousing information management system, we can realize warehouse management functions: goods receiving, goods shipping, cargo managing, order processing, inventory managing, data collecting and process updating. The object of the whole system is goods, combining with RFID technology to realize the automatically managing of goods, reducing manual intervention and lowering the error rate of reading information. The core main function is to realize the automatic information collection of cargo storage, cargo delivery and storage optimization, data acquisition process tag management, data processing and other functions. Figure 1 shows that the article proposed cigarette storage system structure based on the buried RFID cargo tags.

![Diagram of cigarette storage system structure based on buried RFID cargo tags](image)

**Figure 1. Cigarette storage system structure based on the buried RFID cargo tags.**

**Buried RFID cargo tag**

The traditional means of using RFID tags is to install electronic tags on the tray (for carrier smoke barcode data) and RIFD electronic tags is used on high shelves (for carrying cargo information as well as information about cargo on pallets); The system adopts RFID electronic tags and install cargo label on the flat cargo space, however, as a flat pattern buried cargo labels, RFID electronic tags need to resolve several technical difficulties:

1. For the buried labels, using side reading ways to identify, the cross section of the radar label is much smaller than the front, so it requires higher requirements to the physical location of the labels, which means that it needs keep buried condition as long as possible after the truck rolling (including burial depth, orientation, etc.).

2. In buried side reading modes, the effects of environmental factors on the RFID tag identification capability should not be neglected, especially water vapor or dust, so the ways of packaging will be particularly important for seal label.

3. Due to the encapsulated tag being buried in the ground surface, it is complex to change the labels which have reached practical life’s roof or gone to fail. It not only damages structures easily but also makes it difficult to keep the depth and regularity of the original hole on the ground. If
being repeatedly dug, we may even cause damages to the building’s carrying capacity. The consequences would be unthinkable.

In order to get a better resolution to these three issues, we use the following technical solutions.

Buried RFID cargo tag, that includes an RFID tag, epoxy resin chassis, copper, epoxy cover, rubber seals, high strength plastic screws; coppers are engraved with the label position lines, with epoxy resin covered with a label holding tank, and there are six screw holes, a seal groove, with circumference diversion channel and diversion hole around the epoxy cement base, and there are six screw holes on the corresponding positions of the cover. Specific forms are shown in Figure 2.

![Figure 2. Buried RFID cargo tags.](image)

The technical solution adopted designation that separates the cover and the base, and the base is designed with cement diversion channel and diversion holes, which can ensure that it won’t remove in vertical, horizontal and circumferential direction after the completion of displacement. The label is pasted on the copper and installed into the bottom of the base, then stamped with the seal design with the cover, using six high-strength plastic screw to make sure that the cover and base being closely combined, and moisture and dust are not easy to enter into the structure. Meanwhile, the designation of six high-strength plastic screw can greatly share the pressure of forklift which can ensure that the structure is durable, and the plastic material will also not intervene the RFID signal. When replacing tag, you only need to unscrew the screws and open the cover which is very convenient.

**Grading goods assigned storage method based on buried RFID tag**

Methods of grading goods assigned storage based on buried RFID tag include: a number of rectangle-shaped cargo trucks, forklifts used for carrying cargos and installing RFID reader devices, trays, tray electronic tags attached to the tray, buried RFID tags, and WMS systems for information processing.

Many positions mentioned above are equipped with a buried RFID tag which is used to identify the goods, and there are various cargo locating landmarks in the WMS system;

Forklift truck is installed with buried RFID tag with reading information capability and the RFID reader device of the tray electronic tags, mobile data terminals, the RFID tag reader device is connected to the mobile data terminals through Bluetooth, and the mobile data terminal is connected to the WMS system through wireless network, the RFID read-write device could read ID tags in the ordinary conditions. Plastic tray has a fixed mouth with a installed slot in the middle place, and the tray RFID tags are installed in the slot.

Buried RFID tag includes a base plate, circular brass, RFID tags, O-shaped sealed ring and a cover, according to the number of trays that elevator can bear and the data of length and width of
the trays, setting up a corresponding number of circular grooves at the distance of 0.1-0.5m at the front of the elevator, using cement to fix the baseboard in the circular groove, putting circular brass in a fixed position on the base, which is used for RFID to strengthen the reflected signal, putting RFID tags at vertical position with elevator door line and being fixed in the center of the circular plate with double-sided adhesive, fixing the cover with engineering plastic screw head and base plate, sealed O-ring is fixed in the cover for moisture proof and dustproof.

The specific structure is shown in FIG. 3.

Figure 3. Schematic diagram based on buried RFID tag position appointed warehouse map.

(1 forklift, 2 Vehicle RFID read-write antenna 3 vehicle RFID read-write device, 4 vehicle-mounted mobile data terminals, 5 buried RFID grading goods assigned labels, 6 buried the RFID tags, would be 7 matrix shape goods, eight tray, 9 tray RFID tags, 10 handling vehicles)

Based on Figure 3, the specific steps to classify cargo assigned storage method based on buried RFID tag are:

1) The working forklift takes tray, and the system matches the task of tray cigarettes, assigning to target cargo area;
2) The vehicle terminal displays working instructions, and the forklift runs to the target cargo area according to the guidelines;
3) Read the buried RFID hierarchical cargo assign tag or any buried RFID tags in target goods
4) WMS system triggers location assigned, and assign the tray to the target area to determine the position according to certain rules;
5) The vehicle terminal displays the current cargo area map and cigarette storing information, and target cargo information;
6) According to the guidelines, forklift trunk runs to target cargo space, and read the buried RFID tags in this cargo space;
7) WMS system determines the cargo space to place tray cigarette, and complete the job.

Summary
In order to use the existing warehouse space reasonably, and make reasonable layout and planning to the warehouse, so as to obtain maximum storage capacity and maximum storage efficiency, such planning and design are what we usually called warehouse management. Although RFID cigarette tray storage system costs higher at one-time, but it can bring huge benefits in the
realization of automation of logistics management, accelerate the capital turnover, reduce the labor intensity, ensure the production balance, etc.

In order to capture the cigarette’s bar code information quickly and raise cigarette smoke warehousing efficiency, meanwhile inheritance original cigarette storage mode as more as possible, in order to obtain maximum economic benefits with minimal changes. When using the tray as a smoke carrier, use the method associated with electronic tags, making RFID cigarette tray warehouse management system can collect smoke bar code information quickly, establishing a link between electronic tag and tray. This paper combined the characteristics of the cigarette storage systems and RFID technology, researching and designing buried RFID cargo tag, and based on the label, proposing the method that digitizing cigarette tray storage which is used for storing cigarettes grade cargo storage target assigned, resolving issues of the original method of assigning confusion on cargo, slow automotive equipment processing of information, data collection information not matching the actual storage of cargo and other issues

References